**UNIT 3 - AOS 1 MIND, BRAIN AND BODY**

**DOT POINT #3**

* **Sleep as an altered state of consciousness:**

Purpose, characteristics and patterns of the stages of sleep including rapid eye-movement (REM) and the non-rapid eye movement (NREM) stages of sleep

**Learning Intentions:**

1. The characteristics that define sleep as an altered state of consciousness
2. The difference between sleep and normal waking consciousness
3. The difference between REM and NREM sleep (including stages 1-4) in terms of:

* Physiological responses (brainwave patterns; eye movements; muscle tension; heart rate; respiration rate)
* Likelihood of waking
* Likelihood of dreaming and remembering dreaming
* Likelihood of sleepwalking, sleep talking, bedwetting, and experiencing nightmares and night terrors

1. Sleep patterns in terms of:

* NREM/REM cycles throughout the night (as displayed on a polysomnogram)
* Changes throughout the lifespan (age) including the total amount of time spent sleeping and the proportion of REM and NREM sleep

1. The two broad theories that attempt to explain the purpose of sleep:

* Survival (adaptive and evolutionary) theories such as: sleep depends on the need to find food; sleep depends on the animal’s vulnerability to predators; sleep conserves energy
* Restorative (restore and recovery) theories such as: sleep repairs and replenishes the body; sleep activates growth hormone; sleep increases immunity to disease; sleep increases alertness; sleep enhances mood; sleep consolidates memories
* The limitations of these two theories

**Characteristics of Sleep as Altered State of Consciousness**

**Level of awareness:**

* Sleep has a unique state of awareness that is neither awake or in a coma. You have very little awareness of your external environment when you are asleep.
* During the early stages of sleep, however, you may be easily awoken with noises and in deeper stages you may be awoken by highly personally stimulus like a baby crying.
* Compared to normal waking consciousness our awareness during sleep is much reduced.

**Fewer content limitations**

* The contents of our dreams tend to be much broader and deeper that our thoughts in normal waking consciousness

**Controlled and automatic processes**

* Performing other tasks is almost impossible, however, sleep walkers can carry routine, automatic processes like walking along a hallway, going to the toilet or even making a sandwich.

**Perceptual and cognitive distortions**

* Our attention to sensory stimuli is lowered during sleep, including our perception of pain. Our thoughts are more likely to be disorganised and unrealistic during our dreams.

**More or less emotional awareness**

* Our emotions can be more or less intense or flattened during sleep. A nightmare can make us feel very scared and a good dream can make us feel terrific.

**Less self-control**

* Our ability to maintain self-control, including monitoring our own behaviour, is lowered during sleep. E.g snoring, dribbling or sleep-talking.

**Distorted time orientation**

* Our ability to perceive the speed at which time passes may be affected. Time can fly and, on other nights, it can feel as if it takes forever to reach the morning.

**Characteristics and patterns of sleep including REM and NREM stages of sleep**

Sleep is not just one state of consciousness; it comprises a number of predictable states and follows a highly organised sequence of events. Throughout sleep, our bodies shift through a number of stages, each with its unique characteristics.

**A typical night’s sleep**

Throughout a night’s sleep we shift between **non-rapid eye movement** (NREM) and **rapid eye movement** (REM) sleep, beginning with NREM sleep. These occur in continuous cycles, with one following the other and last approximately 90 minutes. The NREM/REM cycle is an example of an **ultradian rhythm,**  biological rhythm that is shorter that 24 hours. Most adults typically experience 4-6 NREM/REM cycles per night. The amount of time spent in REM sleep increases and NREM sleep decreases as the night progresses.

**The sleep journey….**

**Awake**

Our state of consciousness, as marked by our brainwaves, starts to change as we prepare to sleep.

* Awake and alert: when we are up doing homework or watching tv our brainwave activity consists of **beta waves** which are short (low amplitude) and fast (high frequency).
* Awake and drowsy: Just before we fall asleep, we usually close our eyes and relax. Our brainwave patterns are predominantly **alpha waves**  during this time.

**Non-rapid eye movement sleep**

Once asleep, we enter NREM sleep. NREM sleep consists of four stages and accounts for about 80% of our total sleep time. Brainwaves become progressively slower, larger and more regular as we progress through the NREM stages.

* Stage 1 NREM sleep
  + When we transition from awake to sleep we enter a relaxed state known as the **hypnogogic state.** Hypnic jerks – involuntary muscle twitches that cause us to jolt - are common at this stage.
  + This stage is brief and lasts about 5 minutes.
  + Light sleep from which we can be easily awakened
  + Alpha waves begin to be replaced by slower (lower frequency) and larger (higher amplitude) **theta waves.**
  + Our eyes roll slowly, muscles relax and heart and breathing rate decreases
* Stage 2 NREM sleep
  + Many consider that the start of stage 2 as the point where true sleep begins
  + We spend about 20 minutes in stage 2 sleep in our first NREM/REM cycle
  + It is still fairly easy to be woken up, despite being a deeper stage of sleep. If we are woken, it is likely that we still won’t believe we have been asleep
  + Stage 2 is easier to recognise on the EEG than stage 1. It is characterised by the appearance of **sleep spindles (**short bursts of rapid brainwave activity) and **K-complexes** (a single sudden high amplitude wave) among the theta waves.
  + K-complexes occur about once a minute in stage 2 and can be triggered by sleep spindles or an environmental stimulus like a door closing.
  + As we slip further into stage 2 our eyes stop rolling, our muscles become further relaxed and breathing and heart rate continues to decrease
  + Stage 2 sleep accounts for 50 % of our total sleep
* Stage 3 NREM sleep
  + Brief transitional stage that marks the start of deep sleep (slow wave sleep)
  + We become less responsive to external stimuli and more difficult to awaken
  + If woken we feel very groggy and disorientated
  + Slower (low frequency) and larger (high amplitude) **delta waves** become more common. These replace theta waves and sleep spindles and usually occur between 20-50% of the time.
  + Eyes do not move, muscles are relaxed and heart and breathing rates continue to become slower and lower
* Stage 4 NREM sleep
  + Deepest sleep and extremely difficult to awaken
  + Even though our level of conscious awareness is very low, we can still be sensitive to certain stimuli, such as a baby crying or a smoke alarm.
  + In the first NREM/REM sleep cycle, we spend about 30 minutes in stage 4 sleep and it has probably been an hour since we fell asleep
  + Brainwave patterns consist of large delta waves more than 50% of the time
  + No eye movement, little muscle activity and heart and breathing rates are at their lowest.
  + Body temp is lowest in stage 4
  + Sleep walking, talking, night terrors and bedwetting are most likely occur during stages 3 and 4 NREM sleep

**Rapid eye movement sleep**

As the name suggests, REM sleep is a period of sleep when your eyes move rapidly, for short bursts of time. The first cycle of REM sleep lasts for about 10 minutes. REM sleep is lighter sleep than stages 3 and 4 sleep and therefore easier to wake from. Unlike NREM sleep, if we are woken during REM sleep, we are likely to report that we are dreaming.

* Our brains are very active during REM sleep, the EEG patterns resemble those of a person who is awake and alert. Brainwaves are irregular, faster and smaller and resemble the awake beta waves.
* **Sawtooth waves** (a special type of theta-like wave that resembles a saw) may be found amongst the random fast beta-like waves
* Physiological changes during REM sleep
  + Repetitive bursts of rapid eye movement
  + Heart rate, blood pressure and breathing rate increase and fluctuate
  + Body temperature matches the surrounding environment
  + Genitals are aroused
  + No muscle tension – **muscle atonia or cataplexy**

|  |  |  |
| --- | --- | --- |
| **Brainwave pattern** | **Description** | **Association** |
| Beta waves | High frequency (fast) and low amplitude (small) |  |
| Alpha waves |  | The typical brainwave pattern when awake but very relaxed, such as in a meditative state, very drowsy or when we’re about to fall asleep.  Eyes are often closed.  May be seen in people with a coma |
| Theta waves |  |  |
| Delta waves | A steady pattern of low frequency (slow) and high amplitude (large) |  |

**Other brainwave patterns:**

|  |  |  |
| --- | --- | --- |
| **Brainwave pattern** | **Description** | **Association** |
| K-complexes  Sleep spindles | Sharp rise and fall in amplitude lasting for about two seconds)  Periodic bursts of rapid frequency | Both are characteristic of stage 2 NREM sleep |
| Sawtooth waves | Random, fast waves that are slightly bigger than alpha waves | They resemble awake waves but occur during REM and associated with dreaming |

**Summary:**

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (EEG) is a device that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and records electrical activity in the brain in the form of brainwaves.
* Beta waves are the distinctive brainwave pattern that occurs when we are awake and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ waves have a medium frequency and a mixed amplitude.
* When we are lying in bed, feeling drowsy but still awake, we are likely to exhibit \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ brainwaves.
* K-complexes consist of a sharp rise and fall in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and sleep spindles are periodical \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrical activity.
* Sawtooth waves are associated with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sleep.
* The four major patterns of brainwave activity are called:

1.

2.

3.

4.

**ELECTROOCULARGRAPH (EOG)**

The **electrooculargraph (EOG)** is a device that detects, amplifies and records electrical activity in the muscles that allow the eye to move. The resulting signal is called the electrooculargram. It measures the change in voltage as the eyes move and rotate in their sockets.

**What can the EOG tell us?**

**ELECTROMYOGRAPH (EMG)**

The **electromyograph (EMG)** is a device that detects, amplifies and records electrical activity in the muscles. The resulting signal is called the electromyogram. An EMG indicates changes in electrical activity in muscles that accompany changes in states of consciousness.

**What can the EMG tell us?**

**OTHER PHYSIOLOCIAL MEASUREMENTS:**

* 1. **Heart Rate**
  2. **Body Temperature**
  3. **Galvanic Skin Response**

**HEART RATE**

Heart rate may be measured using a standard heart rate monitor or by using a device known as an **electrocardiograph** (EKG) that detects, amplifies and records the electrical activity of the heart muscles. Heart rate is measured in beats per minute (bpm).

**What can the EKG tell us?**

**BODY TEMPERATURE**

Body temperature follows a circadian rhythm; it varies in a regular way over a 24 hour period. It is usually measured by recording the temperature on the skin of the fingers.

Our body temperature tends to peak in the mid-afternoon and reach its lowest point in the early hours of the morning.

Body temperature is linked to alertness and may explain way some cultures encourage mid afternoon siestas and why most accidents occur in the early hours of the morning.

**A graph of body temperature over a 24 hour period:**

**Body temperature in other states of consciousness.**

* **Alcohol-induced state**
* **Ecstacy**

Body temperature is not regulated during REM sleep causing it to drift towards the temperature of the surrounding environment.

**GALVANIC SKIN RESPONSE (GSR)**

The physiological response that indicates the electrical conductivity of the skin is known as the **galvanic skin response (GSR).** As the skin becomes more moist (through perspiration), its conductivity increases.

During normal waking consciousness, events that cause us to perspire such as strong emotional responses or physical activity will increase our GSR. Conversely GSR decreases when we are relaxed and not in a hot environment.

**Limitations of physiological measurements?**

**1.**

**2.**

**OTHER METHODS TO STUDY STATES OF CONSCIOUSNESS:**

1. **The use of Sleep labs**
2. **Video Monitoring**
3. **Self-reports**

**THE USE OF SLEEP LABORATORIES**

A **sleep laboratory** is a place used for scientific research on sleep. It usually resembles a bedroom. The participant stays one or more nights.

**What does the sleep technician monitor?**

**What challenges do sleep labs present for researchers?**

**Limitations of sleep labs?**

**VIDEO MONITORING**

**Video monitoring** is now a common method that can be used both is sleep laboratories and in the participant’s own home. It uses infrared cameras that operate silently to allow footage to be seen and taped in the dark without disturbing the sleeping participant. The recordings can be observed at any time after the period of sleep and given to multiple researchers to interpret. Recordings can also be shown to participants to help them become aware of and understand their behaviour, for example, showing what they do when they sleep walk or even observing the effects of a snoring partner on their sleep.

If done at home, video monitoring allows the participant to sleep in their **natural environment.**

**Limitations of video monitoring?**

**SELF-REPORTS**

**What was the quality of your sleep last night?** You have just completed a self-report.

Self-reports are statements and answers to questions made by participants concerning their thoughts and feelings.

They can be carried out in the following ways:

* Questionnaires
* Diary entries
* Interviews

Self-reports can indicate whether a person is experiencing normal waking consciousness.

For example, asking a person in an ASC to tell a story about something that happened yesterday is likely to generate a response that is missing pieces or does not make complete sense.

**Limitations of self-reports?**

**TEST YOUR UNDERSTANDING**